Watershed Program Annual Report

FY 2005

Photo of Stehekin River, P. Roni

Introduction

The mission of the Watershed Program is to conduct research on physical and biological processes that influence aquatic ecosystems in the Pacific Northwest, effects of land management on those ecosystems, and ensuing effects on the health and productivity of anadromous fish populations and their habitats. We provide technical support to NOAA Fisheries policy makers and regulatory staff, and collaborate with other agencies, tribes, and educational institutions on research and education related to the management of Pacific salmon. Program activities are driven by two broad goals that focus on our mission:

1. Advance the research outlined in our Strategic Research Plan, and
2. Support Technical Recovery Teams and the Regional Office in administering the Endangered Species Act.

Research activities of the Program are guided by the Watershed Program Strategic Research Plan (available at http://www.nwfsc.noaa.gov/research/divisions/ec/wpg/index.cfm). The Strategic Research Plan outlines three primary research themes: 1) landscape analyses and assessments to assist with recovery planning for listed species, 2) fish responses to changes in habitat, watershed or ecosystem conditions, and 3) effectiveness monitoring of habitat and watershed restoration strategies or techniques. Within these themes, the plan highlights a number of priority research topics and projects (Table 1). The following report briefly summarizes progress on each of these goals, as well as details of progress on our research plan, and a summary of Program expenditures. The report was prepared to assist Watershed Program staff and NWFSC leadership in tracking and documenting our progress on our research goals.

Annual report

Staff

In FY 2005 the Program included 15 full-time federal staff members with expertise in fish biology, stream ecology, riparian ecology, landscape ecology, geomorphology, statistics, and population dynamics, as well as 14 contractors, post-docs, interns and part-time staff.

Accomplishing Program goals

The Watershed Program made significant progress on each of the goals set for FY 2005 (Table 2), most notably maintaining a strong record of publishing and presenting research findings. With 102 presentations (Table 3) and 48 publications (Appendices 1 and 2) during the year, the Watershed Program established itself as one of the most productive watershed research groups in the Pacific Northwest. At the same time, the Program maintained a strong commitment to science support for the Regional Office and salmon restoration groups throughout the region. The Program plays a lead role in habitat restoration planning efforts of the Technical Recovery Teams, conducts scientific reviews and analyses to support the Regional Office, and publishes guidance reports such as Ecosystem Recovery Planning for Listed Salmon.

Among the program's notable accomplishments in FY2005 are the completion of a UN report reviewing effectiveness of stream restoration techniques, publication of a book on monitoring stream and watershed restoration, completion of habitat analyses for the Columbia River Hydropower System biological opinion, chairing an American Fisheries Society symposium on restoration in Anchorage, and strengthening our connections with NOAA

Headquarters and raising our international visibility. In addition, we obtained nearly $1 million in external research funds, developed new research projects in urban and agricultural lands, and completed the planning for the fourth biennial Watershed Program Open House (to occur in early FY2006).

The Watershed Program also continues a substantial program of outreach activities, including educational programs at local schools, guest lectures at universities, and serving on advisory committees of graduate students. Members of the Program participate as trainers in regional workshops (e.g., planning and prioritizing stream restoration), serve on science advisory boards (e.g., UW Center for Water and Watershed Studies), and serve on technical review panels for salmon recovery efforts (e.g., reviewed local watershed restoration plans for the Puget Sound TRT).

Research progress

We made significant progress on the components of our research plan (Table 4). Research efforts and publications are spread relatively equally across the research themes, with 28 manuscripts published or in press in 2005, and 20 manuscripts submitted for publication.

Finances

Almost fifty percent of Watershed Program available budget in FY05 was obtained through external funding of our research proposals (i.e., other NOAA and external sources) (Figure 1). Watershed Program Expenditures in FY 2005 were clearly focused on accomplishing our research priorities and supporting the Regional Office, with base funds used almost exclusively to support federal research staff (Figure 1). Thirty-nine percent of our funds supported field studies (technicians, travel, equipment, and sampling costs), sample processing, data analysis, and travel.

Watershed Program goals for FY 2006

The Watershed Program has identified seven goals for FY 2006, four of which are permanent goals that must be met each year. The continuing goals are:

1. Advance the research outlined in our Strategic Research Plan,
2. Support Technical Recovery Teams and the Regional Office in administering the Endangered Species Act,
3. Monitor progress on our research plan, and
4. Complete NOAA annual operating plan (AOP) milestones.

Additional goals that focus on steps the Program should take in FY 2006 are:

5. Increase levels of external funding,
6. Plan research retreat for October 2006, and
7. Increase technical and professional training for staff.

Specific goals that each team will be focusing on include:

Landscape Ecology and Recovery Science Team

- Increase number of publications and speed with which research is translated into publications

- Increase proposal writing
- Improve visibility as leaders in non-native species research
- Increase within team collaborations
- Complete NOAA AOP milestone related to Salmonid Watershed Assessement Model

Ecosystem Processes Team

- Increase emphasis on ecosystem recovery and restoration
- Increase integration of science disciplines within the team, and inter-disciplinary collaboration with other programs and divisions
- Complete NOAA AOP milestone on assessment of productivity of aquatic communities

Restoration Team

- Increase level of focus on watershed-scale restoration monitoring
- Develop a watershed-scale case study to implement watershed-scale restoration planning, implementation, and monitoring
- Complete NOAA AOP milestone data collection on effectiveness of habitat rehabilitation

The above goals will be tracked and reported on in 2007 as part of our regular research planning and reporting efforts. Additional information on specific projects and Program personnel can be found at our website (http://www.nwfsc.noaa.gov/research/divisions/ec/wpg/index.cfm).

Table 1. Primary research objectives of the Watershed Program Research Teams

Landscape Ecology and Recovery Science Team

- Broad-scale relationships among land uses and fish populations
- Appropriate uses of remotely sensed and modeled data
- Impacts of non-indigenous species on salmon and their habitats

Ecosystem Processes Team

- Development of habitat-based salmon life cycle models
- Quantifying stage-to-stage survivals for salmonids in freshwater and estuaries
- Influences of spatial structure (habitat and population) on population responses to habitat change
- Effects of changes in habitat quality on salmonid abundance and survival
- Effects of urban and agricultural development on stream ecosystems
- Lowland river ecology: effects of dams, land use, and channel controls on large river ecosystems and salmon populations
- Watershed-scale management practices and cumulative effects
- Effects of watershed processes and land uses on biological diversity
- Influence of nutrients and light on stream ecosystems

Restoration Team

- Monitor restoration of large rivers and floodplains
- Dam removal: effects of changing sediment supply on habitat and biota
- Influence of watershed-scale restoration on fish growth, movement, and life-stage specific survival
- Effects of restoration at a watershed scale

Table 2. Summary of progress on Program Goals for FY 2005

Goal 1: Advance planned research and monitor progress

- 29 articles, books, book chapters, and reports published or in press (Appendix 1)
- 28 articles, books, book chapters, and reports submitted (Appendix 2)
- 102 presentations, 39 of which were at national and regional scientific meetings
- Significant progress (e.g., data collection, analysis) on field studies, laboratory studies, and GIS/data analysis

Goal 2: Support salmon recovery efforts of the Regional Office and Technical Recovery Teams

- Led habitat analyses for Willamette Lower Columbia TRT (contributing to numerous research reports and publications)
- Collaborated with Center scientists in Puget Sound TRT research (contributing to 6 research reports and publications)
- Consulted with RO on numerous technical issues

Goal 3: Monitor research progress

- Continued annual reporting process to track research progress

Goal 4: Expand research collaborations

- Continued strong research collaborations with agencies, tribes, and universities
- Initiated new research collaborations with UW Climate Impacts Group, Western Washington University, Elwha Research Consortium, and Coastal Rivers Research Consortium (NOAA, USGS, USNPS, USFS, University of Washington)
- Continued strong research collaborations within the Center (currently working with more than 20 Center scientists in other programs and divisions)

Goal 5: Expand research beyond the region and salmon science

- Completed work with the UN to review stream restoration techniques worldwide
- Collaborating with scientists from UC Davis on salmon life cycle modeling in California

Table 3. Summary of presentations by forum and topic area for each research team.

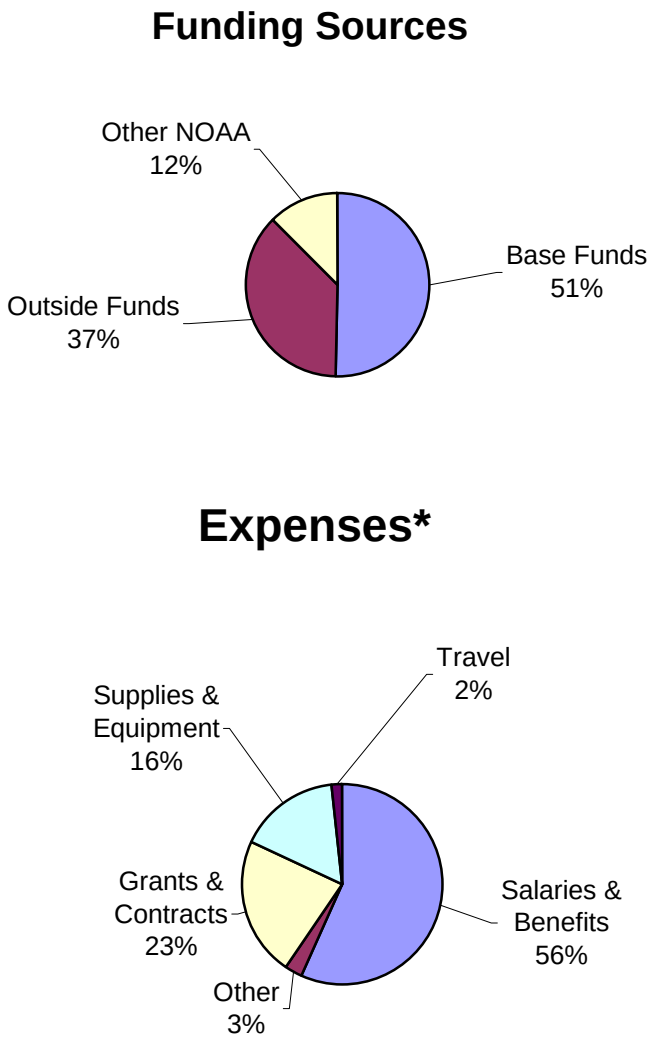
	Landscape Ecology and Recovery Science	Ecosystem Processes	Restoration Effectiveness	Program Total (all teams)
Professional meeting	8	18	13	39
Outreach	1	9	6	16
Workshop	10	7	1	18
University	1	2	3	6
Other	3	7	13	23

Table 4. Progress updates on research projects in the Watershed Program Strategic Research Plan.

Research Area/Project		Research Priority	FY05 Progress
Landscape Ecology and Recovery Science			
	Landscape habitat assessments (SWAM)	1	2 synthesis manuscripts in preparation
	Upper Willamette Temperatures	1	1 manuscript in review
	Ecosystem Diagnosis and Treatment (EDT) sensitivity analysis		2 manuscripts in preparation
	Habitat recovery planning decision support system and sensitivity analyses	1	1 manuscript in review; 4 manuscripts in preparation
	Skagit/Stillaguamish capacity	1	1 manuscript accepted and 1 in preparation
	Hydrologic regimes & life history	1	1 manuscript accepted
	ESU-wide habitat loss	1	Manuscript accepted pending minor revisions
	Sediment reduction prioritization	1	1 manuscript in preparation
	Salmon River life cycle model	1	Not funded
	John Day River life cycle model	1	Not funded
	Non-native species impacts on salmonids	1	Manuscript in internal review
	Puget Sound: habitat for adult and juvenile chinook	1	1 manuscript in review; 2 manuscripts in preparation
	Remotely-sensed data to link habitat and Columbia River salmon	1	Progress report submitted; 1 manuscript in preparation
	Exotic species in estuaries	2	Manuscript in internal review; manuscript in press; manuscript in preparation
	Lowlands streams: land-use and water chemistry	2	1 manuscript in preparation
Ecosystem processes			
	Multispecies life history modeling	1	1 manuscript in preparation (2006)
	Chinook life history modeling	1	2 manuscripts in press; 1 in preparation
	Steelhead life history modeling	1	1 manuscript in preparation (2006)
	Chum/Pink life history modeling	1	1 manuscript in preparation (2006)
	Skagit Bay townetting	1	3 manuscripts in preparation; FY 06 submissions
	Alder study	2	Ph.D. completed; 1 manuscript submitted; 2 in preparation
	Floodplain dynamics	1	1 manuscript accepted; 1 in preparation
	Headwater sediment storage	2	Completed in FY04
	Beaver ponds in floodplains	2	
	Tributary influences/junctions	1	1 manuscript in preparation
	Forest buffers (logging impacts)	2	5 papers published; 1 manuscript in preparation
	Channel incision (grazing impacts)	1	2 manuscripts in preparation
	Puget Sound Ag. land buffers	1	Ph.D. completed; 3 papers in preparation
	Nearshore/estuarine impacts	1	1 manuscript accepted; 1 manuscript in preparation; 2 planned for 2006
	Urbanization- prespawn mortality	1	1 manuscript in preparation
	Mining	3	Not funded
	Effects of water withdrawal	1	1 manuscript in preparation
	Climate change/variability	2	Collaborating with UW CIG
Restoration			
	Off-channel and floodplain restoration	1	1 manuscript published; another submitted
	Stillaguamish/Elwha logjams effectiveness	1	1 manuscript submitted; 1 in preparation

	Coos Bay boulder weirs	1	1 manuscript submitted
	Commencement Bay restoration	1	1 tech memo in preparation, FY 06 completion
	Urban stream restoration	1	MOU signed, study sites selected
	Watershed restoration	1	Progress report completed
	Riparian Restoration	2	1 progress report submitted
	Salmon River nutrient project	1	Continued baseline data collection
	Elwha dam removal	1	4 manuscripts in preparation
	Cedar River fish passage	2	1 manuscript in preparation; 2 MS theses in preparation
	Road restoration	3	Not funded
	Monitoring guidance/methods	1	Published AFS book
	WA ODNR in-channel monitoring design	2	Annual report completed
	Intensively Monitored Watershed Study	2	Two progress reports submitted
	Duwamish restoration	2	1 progress report submitted

Figure 1. Distribution of funding sources and expenditures for Watershed Program FY05.



*Based on actual spending.

Appendix 1. Watershed Program Publications

Beechie, T.J., **M. Liermann**, E.M. Beamer, and R. Henderson. 2005. A classification of habitat types in a large river and their use by juvenile salmonids. Transactions of the American Fisheries Society 134:717-729.

Beechie, T., C.N. Veldhuisen, E.M. Beamer, D.E. Schuett-Hames, R.H. Conrad and P. DeVries. 2005. Monitoring Treatments to Reduce Sediment and Hydrologic Effects from Roads. P. Roni, editor. Monitoring stream and watershed restoration. American Fisheries Society, Bethesda, Maryland.

Beechie, T.J., C.M. Greene, L Holsinger, and E.M. Beamer. In press. Incorporating parameter uncertainty into evaluation of spawning habitat limitations on salmon populations. Canadian Journal of Fisheries and Aquatic Sciences. .

Bisson, P., **T.J. Beechie, and G.R. Pess.** Reconciling Fisheries with Conservation in Watersheds: Tools for Informed Decisions. In World Fisheries Congress Symposium. Vancouver, B.C., Canada. In press.

Booth, D.B., J.R. Karr, S. Schauman, C.P. Konrad, **S.A. Morley**, M.G. Larson, and S.J. Burges. 2004. Reviving urban streams: land use, hydrology, biology, and human behavior. Journal of the American Water Resources Association. 40: 1351-1364. (Published in FY05)

Coe, H., **P. Kiffney**, and G. Pess. Comparison of methods to quantify productivity of wood in large Pacific coastal rivers. Freshwater Biology. In press.

Fullerton, A.H. and G.A. Lamberti. In press. A comparison of habitat use and habitat-specific feeding efficiency by Eurasian ruffe (*Gmnocephalus cernuus*) and yellow perch (*Perca flavescens*). Ecology of Freshwater Fish. Online Early, Sept 2005.

Greene, C.M., D.W. Jensen, E. Beamer**, G.R. Pess, and E.A. Steel.** Effects of environmental conditions during stream, estuary, and ocean residency on Chinook salmon return rates in the Skagit River, WA. Transactions of The American Fisheries Society. Accepted June 2005. In press.

Kiffney, P.M., R.E. Bilby and **B.L. Sanderson**. 2005. Monitoring the Effects of Nutrient Enrichment on Freshwater Ecosystems. P. Roni, editor. Monitoring stream and watershed restoration. American Fisheries Society, Bethesda, Maryland.

Kiffney, P.M., C.J. Volk, **T. Beechie**, G. Murray, **G. Pess**, and R. Edmonds. 2004. A rare disturbance event alters community and ecosystem properties in West Twin Creek, Olympic National Park, Washington. American Midland Naturalist 152:268-303. (Published in FY05)

Kiffney, P.M, J.S. Richardson, and J.P. Bull. 2004. Establishing light as a causal mechanism structuring stream communities in response to experimental manipulation of riparian buffer width. Journal of the North American Benthological Society 54:542-555.

Karlsson, M., J. Richardson, and **P.M. Kiffney**. 2005. Modelling organic matter dynamics in headwater streams of southwestern British Columbia. Ecological Modelling 183: 463-476.

Macneale, K.H., B.L. Peckarsky and G.E. Likens. 2004. Contradictory results from different methods for measuring direction of insect flight. Freshwater Biology (49) 1260-1268. (Published in FY05)

Macneale, K.H., B.L. Peckarsky and G.E. Likens. 2005. Stable isotopes identify dispersal patterns of stonefly populations living along stream corridors. Freshwater Biology, in press.

Medina, A.L., J.N. Rinne and **P. Roni.** 2005. Riparian restoration through grazing management: considerations for monitoring project effectiveness. P. Roni, editor. Monitoring stream and watershed restoration. American Fisheries Society, Bethesda, Maryland.

Morley, S.A., P.S. Garcia, **T.R. Bennett, and P. Roni**. 2005. Juvenile salmonid (*Oncorhynchus* spp.) use of constructed and natural side channels in Pacific Northwest Rivers. Canadian Journal of Aquatic and Fishery Sciences 62: 2811-2821. .

Pess, G.R., **S.A. Morley**, **J.L. Hall** and R.K. Timm. 2005. Monitoring Floodplain Restoration. Chapter 6, Pages 127 to 165 in P. Roni, editor. Monitoring stream and watershed restoration. American Fisheries Society, Bethesda, Maryland.

Pess, G., **S. Morley** and **P. Roni**. 2005. Evaluating Fish Response to Culvert Replacement and Other Methods for Reconnecting Isolated Aquatic Habitats. Chapter 10 Pages 268 to 276 in P. Roni, editor. Monitoring stream and watershed restoration. American Fisheries Society, Bethesda, Maryland.

Pollock, M.M., **T.J. Beechie,** S.S. Chan and R. Bigley. 2005. Monitoring Restoration of Riparian Forests. P. Roni, editor. Monitoring stream and watershed restoration. American Fisheries Society, Bethesda, Maryland.

Pollock, M.M., T.J. Beechie et al. Summer stream temperatures in the Olympic Experimental State Forest, Washington. Annual Progress Report. May, 2005.

Rice, C.A., W.G. Hood, L.M. Tear, C.A. Simenstad, G.D. Williams, L.L. Johnson, **B.E. Feist** and **P. Roni**. 2005. Monitoring Rehabilitation in Temperate North American Estuaries. Chapter 7. Monitoring Stream and Watershed Restoration. P.R. Roni, (ed.). American Fisheries Society, February 2005. 350 p.

Rice, C.A. Effects of Shoreline Modification in Northern Puget Sound: Beach Microclimate and Embryo Survival in Summer Spawning Surf Smelt (Hypomesus pretiosus)." Submitted to Fisheries Management and Ecology. In press.

Roni, P., ed. 2005. Monitoring stream and watershed restoration. American Fisheries Society, Bethesda, Maryland.

Roni, P., A.H. Fayram, and M.A. Miller. 2005. Monitoring and evaluating instream habitat enhancement. P. Roni, editor. Monitoring stream and watershed restoration. American Fisheries Society, Bethesda, Maryland.

Roni, P., K. Hanson, G. Pess, T. Beechie, M. Pollock, and D. Bartley. In press. Habitat rehabilitation for inland fisheries: global review of effectiveness and guidance for restoration of freshwater ecosystems. Fisheries Technical Paper 484. Food and Agriculture Organization of the United Nations, Rome, Italy. (In press)

Roni, P., **M.C. Liermann**, C. Jordan, **E.A. Steel**. 2005. Steps for designing a monitoring and evaluation program for aquatic restoration. P. Roni, editor. Monitoring stream and watershed restoration. American Fisheries Society, Bethesda, Maryland.

Ruesink, J.L., **B.E. Feist**, C.J. Harvey, J.S. Hong, A.C. Trimble, and L.M. Wisehart. In Press. Changes in productivity associated with four introduced species: Ecosystem transformation of a "pristine" estuary. Marine Ecology Progress Series.

Scheuerell M.D., P.S. Levin, R.W. Zabel, J.G. Williams and **B.L. Sanderson**. A new perspective on the importance of marine-derived nutrients to threatened stocks of Pacific salmon (*Oncorhynchus spp*.) Canadian Journal Of Fisheries And Aquatic Sciences 62 (5): 961-964.

Appendix 2. Watershed Program Submitted Publications

Baker, S., F. Damien, **J. Hall**, and **T. Beechie**. In review. Modeling erosion rate increases in the interior Columbia River basin. Submitted to JAWRA. May 2005

Beechie, T., **M. Liermann, M.M. Pollock**, **S. Baker**, and J.R. Davies. Patterns of channel-floodplain dynamics in mountain river systems. Submitted Geomorphology. April 2005.

Beechie, T.J., H. Moir, and **G. Pess.** In review. Hierarchical controls on salmonid reproductive biology. Submitted to AFS edited volume: *Riverine salmonid spawning habitat: physical controls, biological responses, and approaches to remediation*.

Beechie, T.J., M. Ruckelshaus, E. Buhle, **A. Fullerton**, L. Holsinger. In review (accepted with revisions). Hydrologic regime and the conservation of salmon life history diversity. Submitted to Biological Conservation. March 2005.

Courbois, J., S. Katz, C. Jordan, M. Rub, **E.A. Steel**, R.F. Thurow, and D. J. Isaak. In internal review. Sampling strategies for salmon-salmon spawning populations. For submission to *Canadian Journal of Fisheries and Aquatic Science,* Spring 2005.

Davies, J.R., K.M. Lagueux, **B. Sanderson** and **T.J. Beechie** (in review) Modeling stream channel characteristics from drainage enforced DEMs in the Pacific Northwest. Journal of the American Water Resources Association. Submitted May 2005.

Feist, B.E., R. Hilborn, and C.A. Simenstad. Is global climate change accelerating the invasion of non-indigenous smooth cordgrass, *Spartina alterniflora* (Loisel) in Pacific Northwest estuaries? Submitted to *NWFSC Internal Review*. October 2004.

Fullerton, A.H., T.J. Beechie, **S.E. Baker, J.E. Hall**, and K.A. Barnas. In review (accepted with revisions). Regional patterns of riparian condition in the Interior Columbia River Basin, Northwestern USA: Applications for Restoration Planning Landscape Ecology.

Hall, J., D. Holzer, and **T. Beechie**. In review. Modeling floodplain distribution and lateral channel migration potential in the Interior Columbia River Basin, USA. Submitted to JAWRA. May 2005.

Kiffney, P. and **P. Roni.** Abiotic and biotic factors structuring stream invertebrate and vertebrate communities in streams of coastal Oregon. Submitted to internal review. May 2005.

Kiffney, P.M., **C. Greene**, J. Davies, and **J. Hall**. Gradients in habitat heterogeneity, productivity, and diversity of mainstem rivers. Submitted to internal review. June 2005.

Liermann, M., **T. Beechie**, A. Senauer, **S. Baker**, and **K. Kloehn**. Aerial photograph based metrics of floodplain dynamics. Submitted to internal review. April 2005.

Kiffney, P.M, J. Davies, et al. Do tributary streams create gradients in habitat heterogeneity, productivity and diversity of mainstem rivers?

Liermann, M., **T. Beechie**, et al. Metrics of floodplain dynamics based on the age class distribution of stands in the floodplain. Canadian Journal of Forest Research. Submitted to internal review. April 2005.

McMillan, J., S. Katz, and **G. Pess**. In review. Mating system structure and mating tactics of sympatric steelhead (Oncorhynchus mykiss) and resident rainbow trout on the Olympic Peninsula, Washington State. Canadian Journal of Fisheries and Aquatic Sciences

Roni, P., S. Morley, P. Garcia, D. King, C. Dietrich, and E. Beamer. Coho salmon smolt production from constructed and natural floodplain habitats. Submitted to Canadian Journal of Fisheries and Aquatic Science (Sept. 2005)

Roni, P., **T. Bennett**, **S. Morley**, **G.R. Pess**, **K. Hanson**, D. Van Slyke, and P. Olmstead. Rehabilitation of bedrock stream channels: the effects of boulder weir placement on aquatic habitat and biota. Submitted to River Research and Applications. April 2005.

Roni, P., **P.M. Kiffney**, and **S.A. Morley**. In review. Evaluating the effects of habitat enhancement on reach-scale macroinvertebrate metrics in Pacific Northwest streams. Submitted to Restoration Ecology.

Sheer, M.B. and **E.A. Steel.** In internal review. Lost watersheds: barriers, aquatic habitat connectivity, and species persistence in the Willamette and Lower Columbia basins. For submission to Conservation Biology Spring 2005.

Steel, E.A. and I.A. Lange. In Review. Alteration of water temperature regimes at multiple scales: Effects of multi-purpose dams in the Willamette River basin. Submitted to *Journal of Applied Ecology*.

Volk, C. and **P.M. Kiffney.** Nutrient limitation in headwater streams of the Olympic Peninsula, Washington. Freshwater Biology.

Volk, C. and **P. Kiffney**. Nutrient limitation in red alder (*Alnus rubra*) and conifer forested streams of western Washington State, U.S.A. submitted to Aquatic Ecology, August 2005.